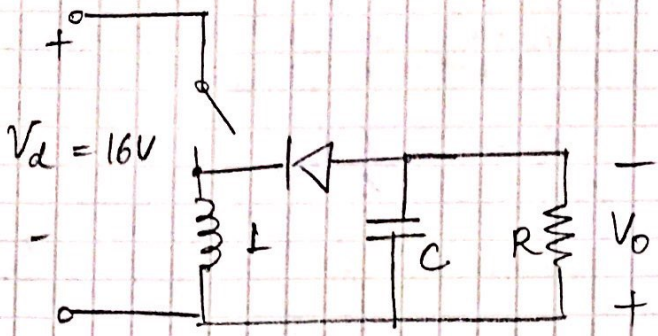
EE464 HW1

Q1 | Buck-boost converter.



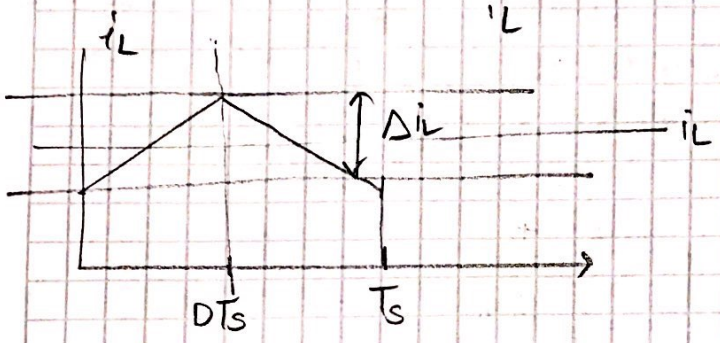
✓ $f_s = 50kHz$

✓ $24W$

✓ $\frac{\Delta V_o}{V_o} \leq 0,02$

$\frac{12}{16} = \frac{D}{1-D}$ → $12-12D=16D$ → $D = \frac{3}{7}$

a) L so that $\frac{\Delta i_L}{i_L} = 0,1$?



$v_L = L \frac{di_L}{dt}$

since the waveform is linear,

$\frac{V_L}{L} = \frac{\Delta i_L}{\Delta t} \rightarrow \Delta i_L = \frac{V_L \Delta t}{L}$

$$\Delta i_L = \frac{16V \cdot 3}{7 \cdot 50kHz \cdot L}$$

Since we know the converter is rated 24W, assuming a lossless operation,

$i_{out} V_{out} = i_{in} V_{in} = 24W \rightarrow i_{in} \cdot 16 = 24W$

$i_{in} = \frac{3}{2} A$

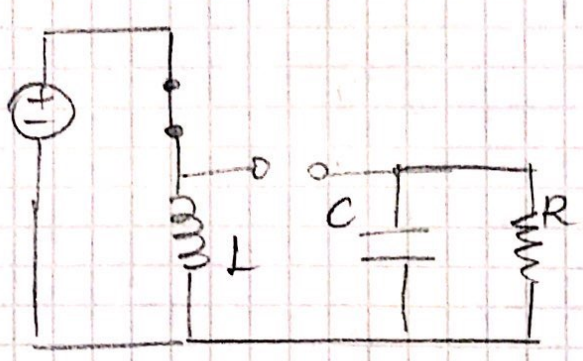
16

Given $\frac{\Delta i_L}{i_L} = 0,1 \rightarrow \frac{\frac{48}{350k \cdot L}}{\frac{3}{2}} = \frac{1}{10}$

$\rightarrow \frac{32}{350k \cdot L} = \frac{1}{10} \rightarrow L \cong 0,914 mH$

b) C so that $\frac{\Delta V_{out}}{V_{out}} = 0,02$?

Consider the ON cycle:



$i_o = \frac{24W}{12V} = 2A$

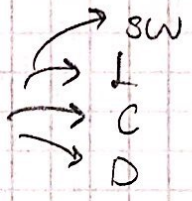
The capacitor will supply the output.
Assuming a constant current at the output

$i_o = C \frac{\Delta V_C}{\Delta t}$

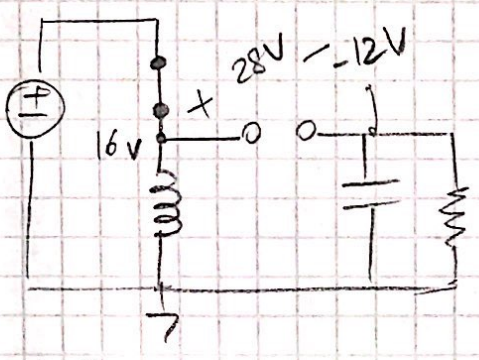
$2A = C \cdot \frac{\Delta V_o}{(D T_s)}$ ↗ $\frac{\Delta V_o}{V_o} = 0,02$ → $\Delta V_o = 0,24$

$C = \frac{2 \cdot 3}{7.50k \cdot 0,24} \simeq 71,43\mu F$

c) Choose commercial products.



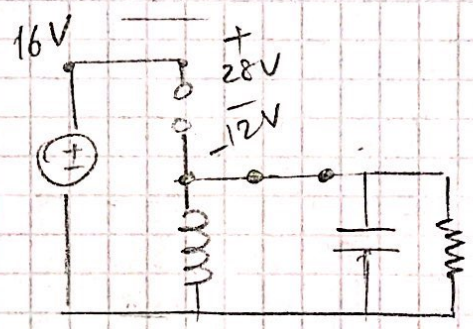
ON



→ D should be able to withstand -28 V.

→ The switch needs to allow an average current of $\frac{4}{3}$ A.

OFF



→ D should be able to carry 2A current.

→ The switch needs to be able to withstand 28V.

- L → watch out for the current rating: 1,5A + 0,1% $\simeq$ 1,65 A_{peak}
- C → watch out for the voltage rating: 12V + 0,02% = 12,24 V_{peak}